

Claims

What is claimed is:

1 1. A shift reactor (16HT, 16LT) for reducing the amount
2 of carbon monoxide in a process gas containing at least
3 carbon monoxide and water, using a water gas shift
4 reaction, the shift reactor having a reaction chamber
5 (32), the chamber having an inlet (36) for entry of the
6 process gas into the chamber, an outlet (38) downstream
7 of the inlet (36) for exit of effluent from the chamber
8 (32), and a catalyst bed (34, 50) located between the
9 inlet (36) and the outlet (38) for converting at least
10 a portion of the carbon monoxide and water in the
11 process gas into carbon dioxide and hydrogen, the
12 improvement comprising:

13 means (40, 40A, 40B, 40C, 40D, 41A, 41B, 41C,
14 41D) for adding oxygen to the process gas in, or prior
15 to, the reaction chamber (32) for causing a reaction in
16 the reaction chamber (32) to enhance conversion of the
17 carbon monoxide in the process gas.

1 2. The shift reactor (16HT, 16LT) of claim 1 wherein
2 the quantity of oxygen added to the process gas is less
3 than about 2.0 mol%.

1 3. The shift reactor (16HT, 16LT) of claim 2 wherein
2 the quantity of oxygen admitted to the reaction chamber
3 is about 0.2 mol%, or less.

1 4. The shift reactor (16HT, 16LT) of claim 1 wherein
2 the catalyst bed (34, 50) in the reaction chamber (32)
3 comprises one or more metals having a promoted support,
4 the metal being selected from the group consisting of
5 the noble metals and the group of non-noble metals
6 consisting of chromium, manganese, iron, cobalt, and

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7 nickel, and the promoted support comprising at least a
8 metal oxide.

1 5. The shift reactor (16HT, 16LT) of claim 4 wherein
2 the catalyst bed (34, 50) comprises a precious metal
3 from the group of noble metals consisting of platinum,
4 palladium, rhodium, and gold, and the metal oxide of
5 the promoted support includes at least one of cerium
6 oxide (ceria) and zirconium oxide (zirconia).

1 6. The shift reactor (16HT, 16LT) of claim 1 wherein
2 the catalyst bed (34, 50) requires neither
3 prereduction, a shutdown purge, nor an inerting
4 atmosphere to operate.

1 7. The shift reactor (16HT, 16LT) of claim 6 wherein
2 the shift reactor is operatively connected in a fuel
3 processing subsystem (14, 16HT, 16LT, 18) for a fuel
4 cell (12).

1 8. The shift reactor (16HT, 16LT) of claim 4 wherein
2 the shift reactor (16HT, 16LT) includes a high
3 temperature stage (16HT) and a low temperature stage
4 (16LT), and said means (40, 40A, 40B, 40C, 40D, 41A,
5 41B, 41C, 41D) for adding oxygen to the process gas
6 introduces said oxygen to the process gas substantially
7 at said low temperature stage (16LT).

1 9. The shift reactor (16HT, 16LT) of claim 1 wherein
2 the addition of oxygen to the process gas causes an
3 oxidation reaction in the reaction chamber (32) for
4 converting a portion of carbon monoxide in the process
5 gas to carbon dioxide.

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1 **10.** The method of reducing the amount of carbon
2 monoxide in a process fuel gas, comprising the steps
3 of:

4 a. placing a catalyst bed **(34, 50)** in a water gas
5 shift reactor **(16HT, 16LT)**;

6 b. feeding **(36)** the process fuel gas into operative
7 proximity with the catalyst bed **(34, 50)** to convert at
8 least a portion of the carbon monoxide in the process
9 fuel gas into carbon dioxide via a water gas shift
10 reaction; and

11 c. supplying oxygen **(40, 40A, 40B, 40C, 40D, 41A,**
12 **41B, 41C, 41D)** to the process fuel gas near, or prior
13 to, the catalyst bed **(34, 50)** for further converting
14 carbon monoxide in the process fuel gas.

1 **11.** The method of claim **10** wherein the catalyst bed
2 **(34, 50)** is selected from one or more metals having a
3 promoted support, the metal being selected from the
4 group consisting of the noble metals and the group of
5 non-noble metals consisting of chromium, manganese,
6 iron, cobalt, and nickel, and the promoted support
7 comprising at least a metal oxide, and wherein the
8 quantity of oxygen added to the process fuel gas is
9 less than about 2.0 mol%.

1 **12.** The method of claim **11** wherein the quantity of
2 oxygen is about 0.2 mol%, or less.

1 **13.** The method of claim **11** wherein the step of
2 supplying oxygen **(40, 40A, 40B, 40C, 40D, 41A, 41B,**
3 **41C, 41D)** to the process fuel gas comprises varying
4 **(41A, 41B, 41C, 41D)** the quantity of oxygen supplied to
5 attain a desired response.

1 14. The method of claim 10 wherein the step of
2 supplying oxygen (40, 40A, 40B, 40C, 40D, 41A, 41B,
3 41C, 41D) to the process fuel gas near, or prior to,
4 the catalyst bed (34, 50) effects an oxidation reaction
5 for further converting carbon monoxide in the process
6 fuel gas to carbon dioxide

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TOTAL 0628760